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7 Financial Assumptions

In IPM, the discount rate and the capital charge rate are the two parameters that encapsulate the financing assumptions for an investment option. The discount rate¹ is necessary for calculation of net present value (NPV). It allows for inter-temporal analysis and represents the time value of money. Annualized capital payments for an investment are computed using the capital charge rate, which takes into account the cost of debt, return on equity, taxes and depreciation.

The EPA Base Case 2000 includes divergent technologies that have different methods of operation, financing, revenue streams, depreciation schedules and risk profiles. Assumptions about the capital charge rate and discount rate in EPA Base Case 2000 reflect these differences and are technology specific. The discussion below describes the methodology and assumptions on the capital charge rate and discount rate in EPA Base Case 2000.

7.1 Methodology

In the EPA Base Case 2000, the assumptions on capital charge rate and discount rate are consistent with valuation techniques in competitive product markets. The use of such a discount rate and capital charge rate allows for an analysis of the impact of environmental air regulations on deregulated electricity markets. Unlike in regulated electricity markets, investors and power plant developers in deregulated markets compete in capital markets without assurances of guaranteed returns for their investments.

The EPA Base Case 2000 uses the Free Cash Flow to Firm (FCFF) valuation technique in determining the capital charge rate and discount rate. FCFF is a valuation technique used for firms where claim-holders include both debt and equity holders. The cash flows remaining after meeting operating expenses and taxes but before making payments to any claim-holders is the free cash flows to the firm. The capital charge ensures that there is enough free cash flow to the firm to meet the obligation to the debt and equity holders.

In the derivation of the assumptions, the capital charge rate is a function of the following parameters:

- Capital structure (Debt/Equity shares of an investment)
- Pre-tax debt rate (or interest cost)
- Debt Life
- Post-tax Return on Equity
- Other costs such as property taxes and insurance
- State and Federal corporate income taxes
- Depreciation Schedule
- Book Life

Similarly, the discount rate is a function of the following parameters:

- Capital structure
- Pre-tax debt rate
- Post-tax equity rate

¹The discount rate in EPA Base Case 2000 is the Weighted Average Cost of Capital (WACC), which is the discount rate when using the Free Cash Flow to Firm (FCFF) valuation technique described later in this section.

7.2 Capital Charge Rates and Discount Rates

In EPA Base Case 2000, the capital charge rate and discount rate vary by the technology of the investment. Two factors play a key role in explaining differences in the capital charge rates and discount rates among technologies: the risk profile of the investment and the applicable financing scheme. These two factors account for the divergence in the depreciation schedule, interest and equity costs, and tax rates, which, in turn, produce different discount rates and capital charge rates.

7.2.1 Risk Profile

The selection of new investment options is partially driven by the risk profiles of these investments. For instance, an investment in a combustion turbine (CT) is likely to be more risky than an investment in a combined cycle (CC) unit because while a CT operates as a peaking unit and is able to generate revenues only in times of high demand, a CC is able to generate revenues over a much larger number of hours in a year. An investor in a CC, therefore, would require a lower risk premium than an investor in a CT. Similarly, an investment in a renewable unit is likely to have a higher risk profile than a CC, due to reliance on an intermittent generation resource (e.g., solar or wind). New nuclear units have a higher risk profile than coal plants due to investor perceptions of the potential risks and consequences of accidents, uncertainty about the storage of spent fuel, and uncertainty in the long-term public commitment to and regulation of nuclear generation. Since investments in new power plants differ in their risk profile, the discount rate and capital charge rate are differentiated among the different classes of potential units based on their perceived risk.

The risk profile assumptions for the different classes of new units modeled in EPA Base Case 2000 are presented below:

Class of New Unit	Risk Profile
Combined Cycle	Medium
Coal and IGCC	Medium
Combustion Turbine	High
Renewable	High
Nuclear	High

7.2.2 Financing Scheme

While the risk profile is a key factor explaining the variation in capital charge and discount rates among different types of new units, the applicability of different financing schemes is a key factor in explaining the differences between the capital charge and discount rates for retrofits of existing units compared with those applied to new units.

In a competitive electricity market as modeled in EPA Base Case 2000, new generating units are assumed to be operated as merchant plants that are financed on a project basis. Project finance, as this category of financing is often labeled, allows developers to seek financing using only the project as recourse for the loan. For instance, a project developer may wish to develop a new combined cycle unit, but will seek to project finance in such a way that if it defaults on the loan, debtors have recourse only to the project itself and not against the larger holdings of the project developer. Project finance is used when a project is a self-sustaining revenue earning entity. Such investments are assumed to have a 30-year book life².

²The debt life and book life of an investment are assumed to be equivalent. Consequently, the book life of the various investments discussed in this section establishes the payback period used in deriving the capital charge rate for each of the investments.

On the other hand, since investments in retrofits on existing plants cannot earn revenues directly, project finance cannot be used for such investments. Furthermore, a corporation that owns an existing unit and seeks to install a retrofit will not be able to issue debt using the retrofit as collateral, since the retrofit has no value independent of the existing plant. Consequently, investments in retrofits on existing units are financed on a balance sheet basis. An investment that is balance sheet financed generally reflects the credit rating of the sponsoring corporation. It is assumed in EPA Base Case 2000 that a balance sheet financed investment in an environmental retrofit has a 30-year book life. The "10-year life extension at age 30" and "20-year life extension at age 40" for existing nuclear plants have corresponding book lives of 10 and 20 years respectively.

Table 7.1 summarizes the assumptions for the capital charge rate, real discount rate, and financing scheme of technologies in EPA Base Case 2000. The last column of this table refers to the two financing approaches discussed earlier in this section: "Corporate" indicates the use of balance sheet financing; "Project" indicates financing on a project basis.

Table 7.1. Capital Charge Rates and Real Discount Rates by Plant Type

Investment Technology	Capital Charge Rate	Discount Rate	Financing Structure
Environmental Retrofits	12.0%	5.34%	Corporate
Nuclear Retrofits (age 30+10 yrs) [†]	19.0%	5.34%	Corporate
Nuclear Retrofits (age 40+20 yrs) [†]	13.3%	5.34%	Corporate
Repowering of Existing Units	12.9%	6.14%	Project
Coal (including IGCC)	12.9%	6.14%	Project
Combined Cycle	12.9%	6.14%	Project
Combustion Turbine	13.4%	6.74%	Project
Renewable Generation Technologies	13.4%	6.74%	Project
Advanced Nuclear	13.4%	6.74%	Project

Note

[†]The capital charge rates for the nuclear retrofit options are those required to yield costs equivalent to the age-related costs assumed in AEO 2000. See section 4.5.1 for a discussion of how the AEO2000 age-related nuclear cost assumptions were adapted for use in EPA Base Case 2000.

Three discount rates are shown in Table 7.1: one for balance sheet financed investments and two for project financed investments. Since balance sheet financing reflects the credit rating of the sponsoring organization, the discount rate for balanced sheet financed projects (5.34%) was derived from financial data for electric utilities. Among the financial parameters considered were utilities typical debt share, equity share, and nominal return on equity (as reported in Value Line); pre-tax debt cost for a Moody's Aaa 10-year average yield; depreciation and federal and state corporate taxes (based on the federal tax code and comparable state sources); and the inflation rate (based on the 12-month Consumer Price Index).

Two discount rates are shown for investments financed on a project basis. The rate (6.14%) for the medium risk investments discussed in section 7.2.1 was based on financial parameters associated with investments having a Baa bond rating. The rate (6.74%) for the high risk investments discussed in section 7.2.1 was based on financial parameters associated with investments having a debt cost that is 80 basis points higher than a Baa bond. Among the parameters considered in deriving these discount rates were debt share, equity share, and nominal return on equity (based on Standard and Poor's industrial 10-year average); pre-tax debt cost (indexed to Moody's 10-year average for Baa bonds), depreciation and federal and state corporate taxes (based on the federal tax code and comparable state sources); and the inflation rate (based on the 12-month Consumer Price Index).

7.3 Discount Rate for Non-Capital Costs

7.3.1 Fuel, VOM, and FOM Costs

The discount rate for non-capital expenditures (e.g., annual fuel, variable operations and maintenance, and fixed operations and maintenance costs) was assumed to be (5.34%). This serves as the default discount rate for all non-capital expenditures.

7.3.2 Intertemporal Allowance Price Calculation

Under a perfectly competitive cap-and-trade program that allows banking, the allowance price always increases by the discount rate between periods if affected sources have allowances banked between those two periods. This is a standard economic result for cap-and-trade programs and prevents sources from profiting by arbitraging allowances between the two periods.

The EPA Base Case 2000 uses the default discount rate of 5.34 percent in computing the increase in allowance price for cap-and-trade programs when banking is engaged as a compliance strategy.

7.4 Treatment of Nominal and Real Dollars in IPM

The EPA Base Case 2000 uses real 1999 dollars for all its simulations in IPM. See Chapter 2 for further discussion on how IPM uses the real dollars for inter-temporal analysis.